Principled and Structured Design of Electronic Materials for Learning the Law

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Abstract. Electronic legal education involves the use of information, communication and instructional technologies to enhance students learning of the law and to provide law teachers with environments and tools for teaching the law. Since the beginning of the Eighties these types of technologies were introduced in legal education at Law schools and faculties of Law. The first applications in this field were databanks of statutes and precedents; soon to be followed by computer assisted instructional programs. With the fast growth of the Internet many Law schools and Law faculties are moving their education and training into the web environment. The web environment enables a more integrated approach of using the technologies in legal education. It also enables teachers to assemble, store and (re) use materials for learning the law. Maybe even more important it may open new ways of teaching and learning the law, for example, by providing students with an environment in which they can manage legal information and legal knowledge for their personal professional use. Plenty of possibilities, however, to realize effective and efficient learning of the law existing electronic materials should be carefully (re)-used and integrated, where new electronic materials have to be designed. The way to realize this is by taking a principled and structured design approach. This indicates that the design of electronic materials for learning the law has to be defined as research. The research field of developing electronic materials for effectively and efficiently learning the law is still in its infancy. Main reason for this is the fact that Law schools and Law faculties approach the development of instructional materials as teaching and not as research. Another reason is that the design of electronic materials for learning the law is by definition interdisciplinary and requires a close relation with both legal research and instructional research. Finally, the few researchers that work in this area are not part of a common research community because there is no such community. There is a need for a forum for researchers and developers of electronic materials for learning the law to define the research agenda. In this paper we define the construction of electronic materials for learning the law as research and we set of defining the research agenda.

Introduction

Electronic legal education involves the use of information, communication and instructional technologies to enhance students learning of the law and to provide law teachers with environments and tools for teaching the law. Since the beginning of the Eighties these types of technologies were introduced in legal education at Law schools and faculties of Law in Europe. The first applications in this field were databanks of statutes and precedents; soon to be followed by computer assisted instructional programs (see, for example, [1, 2, 3, 4, 5, 6, 7, 8,

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9, 10]). With the fast growth of the Internet many Law schools and Law faculties are moving their education and training into the web environment.

The web environment enables a more integrated approach of using the technologies in legal education. It also enables teachers to assemble, store and (re) use materials for learning the law. Maybe even more important it may open new ways of teaching and learning the law, for example, by providing students with an environment in which they can manage legal information and legal knowledge for their personal professional use. To transform these expectations and possibilities into electronic materials for the effective and efficient learning of the law a principled and structured design approach is required, that is, the design of these materials should be based on research outcomes. However, the research field of developing electronic materials for effectively and efficiently learning the law is still in its infancy. Main reason for this is the fact that Law schools and Law faculties approach the development of instructional materials as teaching and not as research. Another reason is that the design of electronic materials for learning the law is by definition interdisciplinary and requires a close relation is with both legal research and instructional research. Then there is the main difference between the Anglo-American legal system and the Continental legal system that makes the sharing of materials hard blocking the formation of an international research community. Finally, the few researchers that work in this area work rather isolated because there is no common research community. There is a need for a forum for researchers and developers of electronic materials for learning the law to define the research agenda, to be able to share research outcomes and electronic materials and to be able to apply research outcomes from relating fields as AI & Law and AI & Education to prevent re-inventing the wheel. In this paper we define the construction of electronic materials for learning the law as research, we take the initiative to set out a research agenda and we describe our research within this agenda.

1 Research Agenda for Designing Electronic Materials for Learning the Law

With the fast growth of the Internet many Law schools and Law faculties are moving their education and training into the web environment. There are new opportunities for (re) using existing applications and designing new electronic materials for learning the law. To transform these expectations and possibilities into electronic materials for the effective and efficient learning of the law a principled and structured design approach is required. Principled and structured design involves three interrelated research streams: basic research, applied research and integration research (see Table 1).

Basic research is concerned with:

- developing well-founded models of legal knowledge and skills to be learned by law students
- examining the difficulties of law students with acquiring legal knowledge and legal skills
- finding remedies to enhance effective and efficient learning of legal knowledge and legal skills

Applied research is concerned with constructing applications for learning the law. Where a principled design approach guides the process in such a way that difficulties and mistakes encountered during the design process may be accounted for.

Integration research is concerned with listing existing electronic materials using a classification and to make applications available for (re) use in what is referred to as a ToolBox for learning the law.

Table 1: Principled and structured design approach

basic research	model construction	theoretical research	legal perspective
			knowledge engineering perspective
		empirical research	
applied research	materials construction		
	remedies		
	instructional model		
	evaluation		
integration	classification		
	selection		

1.1 Basic Research: models of legal knowledge and legal reasoning

The aim of the basic research part is to (re) construct explicit models of legal knowledge and legal reasoning to be applied in electronic materials for learning the law. These models are (re) constructed by way of both theoretical and empirical research.

In the theoretical research component we explore, conceptualize and specify legal knowledge and legal reasoning to be able to (re) construct explicit models of legal knowledge and legal reasoning.

In the empirical research component studies are carried out to acquire insight in the way legal practitioners and legal scientists handle legal knowledge and in the way they use legal knowledge given a specific legal task. Besides that studies are carried out to acquire insight in the way law students handle legal knowledge and apply this knowledge in performing a legal task. The outcomes give indications about specific difficulties in acquiring and using legal knowledge. Within the theoretical research component two perspectives are taken: a legal perspective and a knowledge engineering perspective. The legal perspective is that different legal sources are examined to specify models of legal knowledge and legal reasoning. These legal sources are legal empirical research, legal educational practice, legal dogmatics and legal theoretical research. The knowledge engineering perspective within Artificial Intelligence & Law research aims at constructing models of legal knowledge and legal reasoning. As these models have to be executed by a computer these models require a high level of explicitness. Sergot [11] presents an overview of research on the representation of law in computer programs. Because of the significance of an explicit problem solving method and articulate domain knowledge most of the research described by Sergot are not very interesting for our purpose because these projects can be classified as ‘pre Clancey’.

The model-based approach is the most articulate and structured approach resulting in well-founded problem solving methods for legal tasks. The legal equivalent of the ‘post Clancey’ or model based approach, is the model based legal knowledge engineering approach (see, for instance, [12, 13, 14]). Model-based legal knowledge engineering deals with modeling legal problem solving methods and modeling legal domain knowledge. The model-based approach involves the construction of a set of models of problem solving behavior where a system is a computational realization of these models (see, for instance, [15, 12, 13]). The models serve as a specification of what a system should be able to do, that is, they are specified on the knowledge level. The abstract character of this level also required special specification languages to be able to express the models and to communicate them.

Within the model based legal knowledge engineering approach the emphasis at the moment seems to be more on legal knowledge (see, for instance, [14]). The emphasis is shifted from problem solving methods to the domain knowledge in search for structures that underlie the content of legal knowledge resulting in legal ontologies. Although this is very important, what we need is an integrated and explicit description of both the problem solving method

and the legal knowledge. Within the model based approach we therefore opt for the approach that describes the construction of a model of automated legal reasoning. We are interested in using the legal knowledge in performing a legal task. We want to reveal a structure of use in the legal sources. We therefore turn to a conceptual perspective where statutes are seen as artifacts constructed to perform certain functions. Such a functional viewpoint on legal knowledge is described in the functional ontology of law [12].

As hypothesized by Valente [16] (see also [17]), core ontologies have a functional character and reflect the major reasoning or argument in a field. The functional perspective may be understandable by the fact that fields are typically fields of practice. As a consequence, types of knowledge can be distinguished by their roles.

That these roles may also reflect the predominant structure of reasoning is more speculative, but may be conceived as that domain knowledge is a 'model of the system in the world' and that reasoning means some operation on this simulated system, or the construction of such a system [18]. A legal core ontology describes a coherent view on the legal domain (see, for other examples, [19, 20, 21].

1.2 Applied Research: design of electronic materials for learning the law

In the applied research part the electronic materials for efficiently and effectively learning the law are designed in a principled and structured way, which implies that:

- the basic research results are used in arranging the electronic materials
- the models of legal knowledge and legal reasoning are used in the materials
- on the basis of insight in the specific difficulties of law students in learning the law remedies are constructed to be used in the design of the materials
- instructional design decisions are made on the basis of a global theory on learning and instruction. In this way the design process will result in a coherent and consistent instructional model
- electronic materials are evaluated extensively (developmental testing and field testing).

1.3 Integration research: accomplishment of a ToolBox for learning the law

The integration research part is concerned with the construction of an infrastructure for learning object repositories [22, 23]. It is self-evident to be acquainted with existing tools. However, it is necessary to come up with a classification scheme to be able to integrate these existing applications in a ToolBox. This classification is useful 'to divide and conquer' the complexity and to make clear distinctions between types of applications and ways of realizing them. This division makes it easy to see what tools are already available and what tools are still missing and need to be constructed to really cover all aspects of learning the law. The main idea is to have these different types of electronic materials available in a ToolBox for learning the law. In the ToolBox electronic materials for learning the law are made available to law teachers and law students. The electronic materials in the ToolBox are materials that cover a wide range of legal knowledge and legal skills to be acquired by the law student to become a skilled legal practitioner or legal scientist. The law student and the law teacher may select the proper tools for learning or teaching. To be able to select the proper tools we also need to define selection criteria.

Table 2: Classification of electronic materials for learning the law

electronic materials for learning the law	legal communication tools		
	legal information tools		
	legal instructional tools	knowledge acquisition tools	
		training tools/ coaching systems	environment
			coaching strategy
			knowledge representation
		test tools	

1.3.1 A Classification

The proposed classification distinguishes between communication tools for learning the law, information tools for learning the law and instructional tools for learning the law (see Table 2). Legal communication tools are electronic materials that help to structure, organize and support communication in accomplishing a certain legal task. Legal information tools are electronic materials that contain legal data that are needed in order to carry out a certain legal task. Legal instructional tools are electronic materials for the effective and efficient acquisition of legal knowledge and legal skills. Instructional tools are electronic materials that instruct. With this we mean that the electronic materials are intended to support the learning of a certain body of knowledge or a certain (set of) skills. We classify instructional tools in three different categories:

- Knowledge acquisition tools are tools that support the learner in acquiring the meaning of concepts and the relations between concepts.
- Training tools are tools that use the acquired knowledge in performing a legal (problem solving) task.
- Test tools are tools that present the learner with assignments to test her knowledge and performance.

1.3.2 Coaching Systems

Most of the existing legal instructional materials are training tools or, as they are referred to in the AI & Education community, coaching systems. Coaching systems differ from instructional systems that only present subject matter (domain knowledge) and that only check whether the student has understood the presented material. Coaching systems are computer programs that provide an environment for students to acquire skills in applying domain knowledge and that assess and correct students in their performance. Within this category of training tools we can make a further classification of existing or necessary applications based on the three major factors coaching systems may differ in. The first factor is the degree of similarity of the environment presented to train or learn the task in comparison with the real environment. The second factor is the degree of freedom the student has in performing the task. The third factor is the degree to which a coaching system is able to "understand" what the student is doing and what her results mean.

A task is performed in some environment. This environment defines or instantiates some problem or goal to be achieved and specifies (makes explicit) the conditions (situation) in which this problem is to be solved or this goal is to be achieved. In summary: the environment is a task environment. For real environments coaching systems are in fact "help" systems.

Here a user performs a real life task being the task to be learned or trained in the real life setting. These coaching systems present the user the real environment, not a simulation,

and offer help to the user during task performance. In general, however, the environment in a coaching system is not a real environment, but a representation of reality, i.e. a simulation. Simulation environments can vary to a considerable extend in the way in which reality is represented. Two major categories of simulation environments can be distinguished: model based and non-model based. A model based simulation uses generic models, which enable the generation and interpretation of all possible situations on the basis of these models, whereas in a non-model based simulation all information needed for performing the task, has to be made explicit on forehand. There are two types of generic models: behavioral models and structural models. A behavioral model can either be quantitative or qualitative. Quantitative behavioral models miss matching structural models. These structural models, however, are available with qualitative models that enable a mapping between a behavioral description and input/output relations. The different ways in which the real environment is conceptually simulated is one aspect of a simulation. These should be distinguished from the sensory qualities of a simulation. The conceptual qualities are related to the fact that a simulation must have a correct conceptual correspondence with the real life task to be trained or learned. When there is no conceptual correspondence the simulation is nothing more than facade. The sensory qualities refer to the amount in which the sensory experience in the simulation is identical to the real life experience (for example, in simulating a factory the noise and stench are included). Showing a movie of a real task environment, for example, showing the proceedings of a case before the court, may have high sensory qualities.

A distinction is made between the environment and the coach. Where the environment simulates the problem situation that defines the task to be learned or trained; the coach sees to the learning or training of the skill to be acquired. The coach may vary on task performance that is required or allowed and, related, tutorial style. Coaching systems vary in the degree of freedom the student has in performing the task. To start task performance the student is presented with an initial situation and a problem specification. However, the tutorial style from thereon may vary from constrained to totally free (see, for instance, [24, 25]). In the constrained setting there is an explicit setting of the task. The task is differentiated into a task directed problem or exercise, the goal is stated and the sub-tasks that have to be carried out are traced. In a more free setting the student is presented with a situation. Without explicitly setting a task the coaching system asks the student to explore the environment on the basis of this situation. Another issue here is the appearance of the coach. The coach can either be present as textual feedback and hints, or as a pedagogical agent who is present in the environment (see, for instance, [26, 27])

Coaching systems also vary in the way the knowledge is explicitly represented in the system. Systems that use an implicit knowledge representation encode decisions not knowledge [28, 11]. These systems are for that reason classified as non-intelligent. Systems that do explicitly encode the knowledge are labeled as ‘intelligent’. Explicitness of knowledge representation comes in degrees. With an explicit knowledge representation it is possible to make inferences and to give explanations on the basis of the representation.

There is a strong relationship between the type of simulation of the environment and the type of knowledge representation. A qualitative simulation uses an explicit representation of the knowledge. There is also a strong relationship between knowledge representation and system architecture. Where with an implicit encoding of the knowledge the architecture consists of the sequence of the successive decisions, systems with an explicit representation allow a more modular architecture. Components can be separated on the basis of the function they have in the coaching system.

2 The HYPATIA research program

The proposed research approach described above, distinguishing between basic, applied and integration research and emphasizing the relation with research from fields as AI & Law and AI & Education, is followed in the HYPATIA research program [29]. HYPATIA aims at designing electronic materials for law students to learn the law. The focus in the HYPATIA research program is on *new additional* materials. These materials are intended to support students where they experience difficulties in acquiring legal knowledge and legal skills and materials are not available. HYPATIA develops *new additional* electronic materials for legal education. Law students experience difficulties in acquiring legal knowledge and in using legal knowledge and law teachers report these difficulties. However, there are no materials available to help students to overcome these difficulties. Therefore these types of materials are developed within HYPATIA. The materials are made available in an electronic environment because of the advantages of individualized instruction and practice combined with immediate support and feedback. A computer program has the capacity to adapt to the individual student's performance, it may support the management of information and it may present various representations and vizualisations of legal knowledge and legal tasks. In realizing the electronic materials we take a model based design approach. Models of legal knowledge and legal reasoning are the basis for designing the materials. To (re) construct these models a variety of theoretical sources are examined. Next to this it is necessary to gain insight in the specific difficulties students experience in acquiring legal knowledge and legal skills. Remedies are suggested on the basis of both the models of the legal knowledge and skills and the specific difficulties experienced by law students. HYPATIA is divided into specific research programs. For example, instructional environments for acquiring legal concepts, for learning to use statutes on the basis of insight in the system and structure of statutes, for learning to use precedents on the basis of insight in the structure and elements of precedents, and for learning to solve legal cases.

We shortly describe two projects within the HYPATIA research programs. The first is research on legal case solving and the design of an instructional environment for learning to solve legal cases PROSA. The second is research on precedent analysis and the design of an instructional environment for learning to use precedents PAT (Precedents Analysis Tool).

3 PROSA Problem Situations in Law

The research approach described in this paper was founded and used successfully in the construction of an instructional environment for learning to solve legal cases: PROSA [8, 9, 10]. Although PROSA is a specific application for training the legal task of solving legal cases the approach taken to realize it is reusable for the realization of a variety of applications for learning the law. The legal case solving research within HYPATIA has been realized and reported in detail [8]. This research addressed the problem of arranging instruction for law students to support efficient and effective learning of legal case solving.

The contributions of our research are:

- explicit models of legal case solving
- a precise description of students' difficulties with legal case solving
- a precise description of the causes for these difficulties combined with remedies
- a set of requirements for arranging an instructional environment PROSA, the instructional environment that is effective in improving students' legal case solving performance

Working with PROSA is more efficient than solving cases the traditional way for the following reasons. PROSA takes over the managing of information by externalizing materials, intermediate steps and intermediate results in an automatic way. PROSA facilitates the acquisition of a conceptualization of the legal knowledge by differentiating the knowledge on the basis of its function in legal case solving. Working with PROSA is also better than solving legal cases the traditional way, because the student actively engages in legal case solving. The student actually ”goes through the problem” and learns to differentiate the knowledge and to construct a complete and correct legal solution. Students who worked with PROSA showed a strong improvement in their legal case solving performance, where students who did not work with PROSA did not.

4 PAT Precedent Analysis Tool

Learning the law involves reading, structuring and analyzing precedents to be able to indicate the legal meaning of the precedent. Law students experience difficulties with reading and analyzing precedent cases especially with determining the specific legal meaning of a precedent. Within the current curriculum there is not enough time to read and analyze precedent cases in the presence of a teacher who may provide immediate feedback. Law students are also not presented with models that may guide them in the process of reading and analyzing precedent cases. In learning the law it is essential to know how to structure and analyze a precedent. Therefore we suggest a computer program that presents the law student an instructional environment in which she is able to analyze a precedent in such a way that the structure is made explicit and the legal meaning can be extracted. This can be realized by presenting the student with the text of the precedent (in electronic format) and to present the student a framework for analyzing the text of the precedent. The student can copy and paste parts of the text from the precedent into the framework. This approach also enables comparison of precedents on elements in the framework.

To realize an instructional environment for learning to use precedents the research approach of basic and applied research is taken.

Basic research/theoretical part Design the framework for structuring and analyzing precedents based on the examination of a variety of sources from a legal perspective and from a knowledge engineering perspective

Basic research/empirical part Collect data about the difficulties experienced by law students in reading, structuring and analyzing precedents

Applied research 1) Design of the instructional model, 2) Design of the Instructional Environment for Learning to Use Precedents PAT, 3) Implementation of the instructional environment, 4) Evaluation of the instructional environment

5 Rounding Up

With the fast growth of the Internet many Law schools and Law faculties are moving their education and training into the web environment. The web environment enables a more integrated approach of using the technologies in legal education. It also enables teachers to assemble, store and (re) use materials for learning the law.

Maybe even more important it may open new ways of teaching and learning the law, for example, by providing students with an environment in which they can manage legal information and legal knowledge for their personal professional use. To transform these expectations

and possibilities into electronic materials for the effective and efficient learning of the law a principled and structured design approach is required, that is, the design of these materials should be based on research outcomes. We therefore define the design of electronic materials for learning the law as research. The research should involve basic, applied and integration research, where there should also be an active link to research in the fields of AI & Law and AI & Education. The research agenda proposed in this paper can be used to make inventories of research and applications and to come up with a state of the art and necessary and missing research and applications. In establishing the field of Law & Educational technologies an initiative has been taken to establish a forum for researchers and developers in the field of Law & Educational Technology to discuss current and future research and applications in this field [30].

References

[1] Haft, F., Jones, R.P. & Wetter, Th. (1987). A Natural Language Based Legal Expert System for Consultation and Tutoring - The LEX Project. In *Proceedings of the First International Conference on Artificial Intelligence and Law.* ACM.

[2] Fernhout, F.J., Cohen, M.J., Crombag, H.F.M., Pinckaers, R. & Temme, W. (1987). OBLIGATIO: computer simulatie van juridische casus. In Grave, W.S. de & Nuy, H.J.P. (1987). *Leren studeren in het hoger onderwijs. Perspectieven voor integratie.* Almere. (OBLIGATIO: computer simulation of legal cases).

[3] Span, G.P.J. (1988). De computer als tutor. In Beek, J.F., Boerma, M.J.B. & Hurts, C.M.M. (1988). *Computer-Ondersteund Onderwijs in de Juridische Discipline*. Deventer: Kluwer. (The Computer as Tutor).

[4] Routen, T. (1991). Complex Input: A Practical Way of Increasing the Bandwith for Feedback and Student Modelling in a Statute-Based Tutoring System. In *Proceedings of the Third International Conference on Artificial Intelligence and Law.* Oxford: ACM.

[5] Aleven, V. (1997). *Teaching Case-Based Argumentation Through a Model and Examples*. Pittsburgh: University of Pittsburg.

[6] Nadolski, R. & Wöretshofer, J. (1998). *Handleiding CD-rom-programma Arrondissement Zomerweelde*. Heerlen: Open Universiteit. (Manual CD-rom program District Court Summer Bliss).

[7] Blackie, J. & Maharg, P. (1998). The Delict Game. In *Proceedings 13th BILETA Conference The Changing Jurisdiction.* Dublin.

[8] Muntjewerff, A.J. (2000). *An Instructional Environment for Learning to Solve Legal Cases. PROSA.* Amsterdam: University of Amsterdam. See also http://www.lri.jur.uva.nl/∼munt

[9] Muntjewerff, A.J. & J. Groothuismink (1999b). Supporting the Learning of Legal Case Solving using a Computer Program as the Instructional Environment. In *Proceedings CATE'99 Computers and Advanced Technology in Education*. Philadelphia, USA: IASTED.

[10] Muntjewerff, A.J. (2002). Evaluating the Instructional Environment for Learning to Solve Legal Cases PROSA. In Gustavo A. Santana Torrellas ans Vladimir Uskov (eds.). Proceedings of the IASTED International Conference Computers and Advanced Technology in Education. Anaheim Calgary Zurich: ACTA Press: , pp. 374 - 379.

[11] Sergot, M. (1991). The Representation of Law in Computer Programs: A Survey and Comparison of Past and Current Projects. In BenchCapon, T.J.M. (Ed.). *Knowledge Based Systems and Legal Applications*. London: Academic Press.

[12] Valente, A. (1995). *Legal Knowledge Engineering*. Amsterdam: IOS Press.

[13] Haan, N. den (1996). *Automated Legal Reasoning.* Amsterdam: Thesis University of Amsterdam.

[14] Haan, N. den & Sartor, G. (1999). Editorial: Model-based Legal Knowledge Engineering. In Gaines, B.R. (Ed.). *International Journal of Human-Computer Studies. Special Issue Model-based Legal Knowledge Engineering.* Academic Press, pp. 1037 - 1042.

[15] Breuker, J.A. & Van de Velde, W. (1994). *CommonKADS library for expertise modeling. Reusable problem solving components.* Amsterdam: IOS Press.

[16] Valente, A. J.A. Breuker. & W. Van de Velde (1998). The CommonKADS Library in perspective, *International Journal of Human Computer Studies,* 49, 391 - 416.

[17] Valente, A., J.A. Breuker & P.W. Brouwer (1999). Legal modelling and automated reasoning with ONLINE. *International Journal of Human-Computer Studies*. Special Issue Model-based Legal Knowledge Engineering, 51, 6, pp. 1079 - 1125.

[18] Clancey, W.J. (1992). Model construction operators. *Artificial Intelligence*, 53, pp. 1 - 115.

[19] McCarthy, L.T. (1989). A language for legal discourse. In *Proceedings of the 2nd International Conference on AI and Law*. Vancouver: ACM.

[20] Visser, P.R.S. (1995). *Knowledge Specification for Multiple Legal Tasks. A Case Study of the Interaction Problem in the Legal Domain.* 's-Gravenhage: Kluwer Law International.

[21] Kralingen, R.W. van (1995). *Frame-based Conceptual Models of Statute Law.* 's-Gravenhage: Kluwer Law International.

[22] M. Hatala & G. Griffiths, Pool, Pond and Spash: A Canadian Infrastructure for Learning Object Repositories. In: G.A. Santana Torellas and V. Uskov (eds.), Proceedings of the 5^{th} IASTED International Conference Computers and Advanced Technology in Education. ISBN: 0 88986 332 6. ACTA Press, Anaheim-Calgary-Zurich, 2002, pp.254-259.

[23] H. van Vliet & M. Grootveld, Engeneering Educational Content. In: G.A. Santana Torellas and V. Uskov (eds.), Proceedings of the 5^{th} IASTED International Conference Computers and Advanced Technology in Education. ISBN: 0 88986 332 6. ACTA Press, Anaheim-Calgary-Zurich, 2002, pp .242-247.

[24] Berkum, J.A. van & T. de Jong (1991). Instructional environments for simulations. *Education & Computing* 6, pp. 303 - 358. Amsterdam: Elsevier.

[25] Jong, T. de, W. van Joolingen, D. Scott, R. de Hoog, L. Lapied & R. Valent (1994). SMISLE: System for Multimedia Intergrated Simulation Learning Environments. In Jong, T. de & Sarti, L. (Eds.). *Design and Production of Multimedia and Simulation-based Learning Material*. Dordrecht: Kluwer Academic Publishers.

[26] Lester, J.C., S. Converse, B. Stone, S. Kahler & T. Barlow (1997). Animated pedagogical agents and problem-solving effectiveness: A large-scale empirical evaluation. In *Proceedings of the Eight World Conference on Artificial Intelligence in Education,* pp. 23 – 30. Amsterdam: IOS Press.

[27] Shaw, E., R. Ganeshan, W.L. Johnson, & D. Millar (1999). *Building a Case for Agent-Assisted Learning as a Catalyst for Curriculum Reform in Medical Education*. http://www.isi.edu/isd/ADE/ade-body.html.

[28] Wenger, E. (1987) *Artificial Intelligence and Tutoring Systems. Computational and Cognitive Approaches to the Communication of Knowledge*. Los Altos, California: Morgan Kaufmann Publishers inc.

[29] Muntjewerff, A.J. (2002). HYPATIA research program. Models of Legal Knowledge and Legal Reasoning in Electronic Materials for Learning the Law. Amsterdam: University of Amsterdam, ISBN 90-806969-1-9.

[30] http://www.lri.jur.uva.nl/LETA